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ABSTRACT

A study was conducted among 332 young women at Harcum Junior College to investigate the relationship between eating patterns and academic achievement. Two groups were compared, one eating two or three regular meals daily (A) and one eating less than two regular meals daily (B). For each student in Group A, one was included in Group B who matched her Scholastic Aptitude Test scores within 50 points. By following this sample selection method, the aptitude-matched groups were analyzed in terms of their graduation cumulative grade point averages. The t-ratio for the obtained difference between the mean GPA (2.9) for Group A and the mean GPA (2.6) for Group B was 2.60, showing a reliable correlation between higher achievement and good eating habits. Many variables in determining the exact nutritional intake of students prevents generalization from these results, but further study of collegiate nutrition and achievement is recommended. (Author/MJK)

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HARCUM JUNIOR COLLEGE
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Some Biochemical Correlates of Academic Achievement
(College Women - Their Eating Habits & Academic Achievement)

Statement of Problem

This pilot study was designed to investigate the relationship, if any, between the eating patterns of college women and their academic achievement. If the null hypothesis is rejected, because the differences in academic performance between the samples is too great to be reasonably attributed to sampling fluctuations, the implications might well be of significant consequence, both in terms of student academic achievement and their levels of mastery learning, or for effective articulation into the'world of work'.

Literature Review

Although much attention has been given to the impact of proper nutrition upon school progress and learning among younger children, at the collegiate level one finds few literature citations. A literature search in the late Spring of 1974, (conducted through the Lockheed Information Retrieval Service, gave access to the following major data bases:

(1) NTIS - The complete Government Reports Announcements file from the National Technical Information Service, consisting of more than 325,000 abstracts of government research from over 240 agencies.

(2) ERIC - The complete file of educational materials from the Educational Resources Information Center of the National Institute of Education; including some 70,000 abstracts listed in Resources in Education, and 68,000 abstracts of journal articles in education listed in the Current Index to Journals.

(3) Psychological Abstracts - Over 125,000 abstracts to journal articles in psychology, issued by the American Psychological Association.

This search yielded an abstracts bibliography of some 93 items which relate, broadly, to nutrition and eating habits. Among these, however, no item was cited which related specifically to this subject of eating patterns among college women and their academic achievement.

A similar search was made of College Student Personnel Abstracts for the five year period 1970-74. This compilation of abstracts from journals, conference proceedings, and research reports pertaining to college students and college student services also did not reveal any germane citations.

Dr. Kasl [1] of Yale University noted, in 1974,...."Our understanding of scholastic performance and achievement has reached a plateau, since it would appear that the major ability and motivational determinants (and the associated background and socio-environmental factors) have been identified, assessed, and tested out for their predictive usefulness. A significant improvement in our understanding and prediction of scholastic achievement could come from the identification of new, relevant ability dimensions or from a considerable improvement in our assessment procedures of the more elusive motivational variables, but

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at the moment neither possibility appears very likely. Another strategy is to go to a radically different class of variables that have so far been largely unexplored (underlining supplied), and to identify one or more variables which show promise of accounting for some of the unexplained variance in scholastic achievement.

"Biological or biochemical variables are such a class and, off and on in the past, educators have been intrigued and tantalized by them".... However, "the absence of any striking success from the previous sporadic work in this domain rules out any reasonable hints of an impending 'breakthrough'." Yet, if there are such promising biochemical correlates of scholastic achievement, these might well serve to improve our predictions of scholastic success. It is also true, as Kasl points out, that some work with biochemical variables, (Vogel, Broverman, Droguns, & Klaiber) (2) with glutamic acid, shows encouraging promise.

From the storehouse of available cliches, one that seems appropriate to this topic is— "we are what we eat." This folk-wisdom appears to be generally supported in those findings which relate nutritional input and behavior, performance, achievement, motivation, etc. Specifically, there is evidence, as Kasl points out in his broad review..."that serum uric acid (SUA) possesses considerable promise as an indicator of one type of biochemical influence on achievement behavior.... Orowan (1955) was perhaps the first to hypothesize explicitly that high SUA levels and superior attainment may be associated. Noting that uric acid has molecular structure similar to other purines, caffeine, theobromide, and theophylline, Orowan speculated that uric acid may have the ability to stimulate the cerebral cortex and that its association with achievement is via its role as a cortical stimulant." (3)

The hypothesis..."asserting a positive association between SUA and superior achievement and accomplishment...has received the most encouraging support to date. The evidence comes primarily from two types of studies: comparisons of different occupational groups, and investigations of high school and college students and of university professors....It is important to remember that....only male subjects were included. Women have been almost totally ignored so far."(4) (Underlining supplied)

"The results from studies of high school and college students (Dunn et al.;(5) Gordon, Linderman & Gordon (6), Kasl, et al.;(7) Kasl, Brooks, & Rodgers (8) (9) (10) provide us with some of the richest data on the association of SUA levels and achievement. We find, first of all, that students who are in the top quarter of their graduating class on grade-point average have considerably higher serum urate levels than the remainder of the class. And if one examines grades and IQ simultaneously, one finds that the high serum uric acid students have considerably higher grades than one would expect on the basis of ability (IQ) alone. It was also shown that on several standard tests in which performance depends on how hard the student works (motivation and speed), as well as on ability, the high serum uric acid students perform better than those whose uric acid levels are relatively low.....

"In short, a variety of indicators - grades, test performance (on speed tests - but not on power tests), extracurricular activities, teachers' ratings - converge in characterising the high SUA students as higher on achievement-related behavior."....

"An interpretive summary of the evidence on SUA would suggest that there exists a good deal of support for a general theoretical framework in which high serum urate levels are seen as indicative of a high level of stimulation (arousal or activity level).....

"This kind of interpretive summary, of course, ignores large gaps in our knowledge and in the evidence... First of all, the data on uric acid as a cortical stimulant are very scant and scattered: Glumatic acid, a metabolic precursor of uric acid, has been implicated in cognitive functioning (Vogel, et al.) (11)..... However, we are still totally ignorant of the short-and-long-term effects on a whole range of behaviors, from simple reaction time to cognitive functioning to stable achievement-oriented behavior.....

"In short, we need many more studies which deal with such issues as: (a) biochemical correlates of achievement in women, (b) pharmacological control of SUA levels, (c) metabolic pathways involved in normal and elevated levels of SUA, or (d) the mechanism involved in the causal influence which uric acid may exert on specific types of behavior or performance." (12)

And finally - a search by ERIC/Higher Education of George Washington University in April 1975 revealed only 10 citations in Resources in Education and Current Index to Journals of Education. All were tangential to the specific topic of this inquiry: College women-their eating habits and academic achievement.

References

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(2) Vogel, W., Broverman, D., Droguns, J.G. & Klaiber, E. L. The role of glutamic acid in cognitive behavior. Psychological Bulletin, 1966, 65, 367-382

(3) Kasl, op cit. (p. 448)

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(6) Gordon, R.E., Lindeman, R. H., & Gordon, K. Some psychological and biochemical correlates of college achievement. Jrnl of the Amer. College Health Assoc. 1967, 15, 326-331.

(7) Kasl, S.V., Brooks, G.W., & Cobb, S. Serum urate concentrations in male high school students. A predictor of college attendance. Jrnl. of the Amer. Med. Assoc. 1966, 198, 713-716.

(8) Kasl, S.V., Brooks, G.W. & Rodgers, W.L. Biochemical correlates of achievement and motivation. Final Report, Project No. 8-0082, Grant No. OEG-0-8-080082-3520 (085), HEW, Office of Education, Bureau of Research, Sept. 1969.

(9) Kasl, Brooks, Rogers. Serum uric acid and cholesterol in achievement behavior and motivation. I. The relationship to ability, grades, test performance and motivation. Jrnl of the Amer. Med. Assoc. 1970, 213, 1158-1164.

(10) Kasl, et al. Serum uric acid, etc. etc. etc. II. The relationship to college attendance, extra-curricular and social activities, and vocational aspirations. Jrnl of the Amer. Med. Assoc. 1970. 213, 1291-1300.

(11) Vogel, W. et al. op cit.

(12) Kasl, S. op cit. pp. 451, 455, 456, 457.

Method

In 1974, all Harcum Junior College students were invited to complete a brief questionnaire (See Appendix A) which requested them to self-identify their eating patterns. Some 420 young women did so.

To help avoid data contamination resulting from including students with non-comparable academic potential, as measured by the CEEB Scholastic Aptitude Test, only those 'matched' in such scores were included in the statistical treatment of data obtained. (As the CEEB has noted - "the SAT is subject to 'errors of measurement', as is true of all tests and measuring devices generally. Scores fluctuate around an average which can be thought of as a 'true score' for the individual. For both the SAT Verbal and Mathematics sections this is a range extending from 30-plus points below to 30-plus points above it. .... Small differences between scores do not necessarily indicate real differences in ability." Thus - individuals whose SAT scores are within 50 points of each other may, in accordance with this rationale, be considered as 'matched' in terms of the academic potential measured by the SAT.

Specifically, for each student in Group A (those eating 2 or 3 regular meals a day), one within the 50 point SAT range was included in Group B (those eating less than 2 regular meals daily). Through this method of sample selection, any differences found in grade-point averages among these two sub-groups could not reasonably be attributed to differences in academic potential as measured by the SAT. Presumably, such differences are associated with factors other than academic potential as measured by the SAT.

By following this sample-selection method, two groups totaling 332, were analyzed in terms of their graduation cumulative averages; the data being treated statistically to ascertain if significant differences existed among these sub-groups.

Results

Perhaps the most common problem in research is to determine whether two samples differ sufficiently in one or more characteristics to discredit the hypothesis that the samples are from populations similar in the characteristics chosen for comparison. If the difference between the samples is too great to be reasonably attributed to sampling fluctuations, the "null" hypothesis is rejected, and the conclusion follows that a <u>real</u> difference exists between the populations from which the samples were drawn. Such non-chance, or <u>real</u> differences which cannot reasonably be ascribed to chance fluctuations, are at a confidence or probability level generally termed as statistically significant.

To determine if the obtained difference between the means of the graduation grade-point averages among Groups A & B students was likely to be a chance or statistically significant one, the t-ratio was applied to these data.

How large must a t-ratio be before an obtained difference between two means can be considered 'significant'? A convention, or arbitrary agreement, stipulates that the obtained difference must be at least large enough so that it could arise by chance variation only 5% of the time if there were, in fact, no true difference between the means of the populations from which the samples were drawn; (the so-called "5% level of confidence").

A t-ratio of 3 is a virtual certainty (about 999 chances in 1000) that a true ('significant') difference exists between the means of the two populations from which the samples were drawn. A t-ratio larger than 3 is that much more assurance that a 'significant' difference exists.

Speaking literally, there is never absolute certainty in scientific inquiry. All conclusions drawn from experiments contain an element of risk. However, what the t-ratio procedure permits one to state, quite precisely, is the extent of the risk. Therefore, for t-ratio of 3 or greater, the probability of an obtained difference being due to sampling fluctuations, or other chance variations, is less than 1 chance in 1000 -- or a very high "level of confidence" that such a difference reflects a true difference in the characteristic chosen for comparison.

The t-ratio for the obtained difference between the mean grade-point average (2.9) for Group A (those eating 2 or 3 meals regularly) and the mean grade-point average (2.6) for Group B (those eating less than 2 meals daily), was 2.60. This translates into 995 chances out of 1000 that replication of this experiment would turn out the same way, i. e., a higher mean grade-point average for those eating 2 or 3 meals daily on a regular basis. With a confidence or probability level of less than .01, the data generated may be termed as being "very reliable".

Discussion/Conclusion

Based upon the results obtained in this preliminary or pilot inquiry, it would appear entirely reasonable to suggest that further inquiry into the nutritional biochemical correlates of academic achievement for collegians - both female and male, might be fruitful.

For example, what reliable differences in academic achievement, if any, exist between those who snack between meals; those who do not; those who regularly eat 2 to 3 meals daily; and those who do not regularly eat 2 to 3 meals daily - (The multi-faceted area of 'balanced' nutrition and achievement-performance)? In terms of 'higher' and 'lower' cumulative grade-point averages earned, are there any statistically-significant differences in specific foods eaten at regular meals? —— in 'snack' foods eaten? Many other variables might also be investigated.

If the inquiry here is replicated several times, and the results show consistent directional findings and meaningful strengths of association, at that point it would then be appropriate to generalize the results. However, it does not appear unwarranted to suggest, tentatively, that nutritional biochemical correlates of academic achievement which are known to affect academic achievement of younger children might well also be an important factor in the academic achievement of collegians.

Boris Blai, Jr., Ed. D.
Dean of Administration

1975

HARCUM JUNIOR COLLEGE
Office of Research

QUESTIONNAIRE

May 1974

College Women - Their Eating Patterns

Harcum and other colleges are studying eating patterns of contemporary college women. How frequently do they not eat breakfasts? Do many of them typically not eat lunch? Do they 'snack' between meals?

It is necessary in this survey to identify individuals, as additional information will be obtained from their college records. However, you have my absolute assurance that this data sheet will be destroyed without divulging its contents to anyone, after I have tallied the information it contains.

Thank you for your helpful assistance.

Boris Blai, Jr., Ed. D.
Director of Research

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NAME (Please PRINT) _____

Junior _____ or Senior _____
Day _____ or Resident _____

1. Typically, for each Monday through Friday, I eat breakfast:
   5 days _____ 4 days _____ 3 days _____ 2 days _____ 1 day _____
2. Typically, my daily breakfast consists of: (Please check EACH item that applies)
   fruit juice _____ toast or rolls _____ butter _____
   Cereal _____ milk _____ jam or jelly _____
   eggs _____ coffee _____ bacon or sausage _____
   pancakes/waffles _____ tea _____ other? _____
3. Typically, for each Monday through Friday, I eat lunch:
   5 days _____ 4 days _____ 3 days _____ 2 days _____ 1 day _____
4. Typically, my daily lunch consists of: _____
5. Typically, for each Monday through Friday, I eat dinner:
   5 days _____ 4 days _____ 3 days _____ 2 days _____ 1 day _____
6. Typically, for each Monday through Friday, I 'snack' between meals:
   5 days _____ 4 days _____ 3 days _____ 2 days _____ 1 day _____
7. My 'snacks' usually consist of: _____
8. Typically, how many times a day do you 'snack"? _____

UNIVERSITY OF CALIF.
LOS ANGELES

SEP 12 1975

CLEARINGHOUSE FOR
JUNIOR COLLEGE
INFORMATION

(Appendix A)